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EVALUATION OF A CONTROLLED RELEASE FORMULATION OF METHYL-CYCLOHEXENONE (MCH) IN PRE-VENTING SPRUCE BEETLE ATTACK IN ALASKA

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ABSTRACT

A methylcyclohexenone bubble cap (a controlled release device) was tested at two spacings (1 and 3m) for prevention of spruce beetle attacks in felled white spruce near Juneau Creek on the Chugach National Forest, Alaska. There were no significant differences in the suppression of beetle attacks between treated and felled check trees. Factors such as cool temperatures affecting expected release rates are discussed.

INTRODUCTION

The spruce beetle, *Dendroctonus rufipennis*, is the most destructive pest of white, *Picea glauca*, Lutz, *P. glauca* x *lutzii*, and Sitka, *P. sitchensis*, spruce in south-central and southeast Alaska (Werner et al. 1977). Infestations presently cover 100000 hectares of which 11255 hectares occur on the Chugach National Forest.

There are a variety of control techniques recommended for spruce beetle supression. These include the immediate salvage of infested material in conjunction with trap trees (Gibson 1984), insecticide treatments (Werner et al. 1983, 1984), and use of attractant baited traps to reduce beetle populations.

Another technique is the use of synthetic anti-aggregating compounds to prevent attack or reduce beetle attack density to a level below the threshold density required for the development of brood trees. Recently, a granular controlled-release formulation of methylcyclohexenone (MCH) was aerially applied to 76.9 hectares of uninfested Douglas-fir (*Pseudotsugae menziessi*) and Englemann spruce (*P. engelmanni*) in Idaho (McGregor et al. 1984). The treatment resulted in a 94.6% reduction in Douglas-fir beetle infestations and reduced spruce beetle attacks by 55%.

For the past three years, field studies have been undertaken in Alaska to test the efficacy of slow release formulations of MCH for the prevention and/or reduction of spruce beetle attacks in spruce(Holsten and Werner 1984, 1985). Liquid and granular controlled release formulations of MCH were tested at three dosages each. The best granular treatment (9.2 kg/ha) reduced beetle attacks and subsequent progeny by 70% and 61% respectively, when compared to the untreated controls (Holsten and Werner 1984). However, a similar study conducted the following year (Holsten and Werner 1985) resulted in no significant differences between treated and felled check trees. Results indicated that cooler spring and summer temperatures reduced the elution rate of formulated MCH to lower than expected rates. It was felt that the field elution rate of MCH might have to be doubled

or tripled to be effective against the spruce beetle in Alaska.

In addition to the use of liquid and granular slow release MCH formulations, a bubble cap release device was developed at the University of British Columbia. This bubble cap is easily suspended in traps or stapled onto the bole of windthrown or felled trees. Recently, MCH bubble caps were tested in Montana for the suppression of spruce beetle attacks on Engelmann spruce (Lindgren and McGregor 1985). The attack density of the spruce beetle was reduced by 25% of that on untreated felled Engelmann spruce trees. Based on the results of the Montana study, we decided to test the bubble caps for suppression of spruce beetle attacks under Alaska conditions.

MATERIALS AND METHODS

Study Site: The field test was conducted in a Lutz spruce stand west of Juneau Creek and south of Round Mountain on the Chugach National Forest (latitude 60°30'N, longitude 149°45'W). This area is composed of mature Lutz spruce mixed with Lutz and black spruce (*P. mariana*) saplings. Average diameter and height of the dominant and co-dominant spruce used in the study were 31.9 cm and 22.1 m, respectively. Beetle populations were epidemic throughout the study area encompassing more than 460 hectares.

Treatments: The experimental design was a completely randomized block with two treatments and a check, each replicated ten times. Thirty uninfested Lutz spruce were felled in early May along three east-west transects. Each tree and transect was at least 30 m from the next experimental tree and felled to allow shading to the sides and top of the bole.. Air temperature was recorded hourly on a Belfort[R] hygrothermograph placed within the center of the study area.

The bubble caps used in the Montana study (Lindgren and McGregor 1985) released MCH at 0.5 mg/24 hrs and were tested at spacings of 1.5 and 3 m between caps along the upper bole of the felled trees. Results of this study demonstrated no difference in efficacy at the two spacing intervals; however,

there was an apparent ultra-violet breakdown of the upper membrane resulting in increased elution and a shorter life expectancy of the release device. According to Phero Tech Inc, Vancouver, B.C., the firm developing the bubble cap technology, the upper membrane "problem" was rectified. We also decided to test the MCH bubble caps at a 1.5 and 3 m spacing along the tree bole. Each bubble cap was attached to the unlimbed tree during the third week of May on the top side of the bole by means of a heavy duty staple. Each 5 cm^2 bubble cap was reported to release 0.9 mg MCH/day, at an average temperature of $20^{\circ}C$, with a duration of 75 days (25% overload as a safety margin, therefore caps loaded for 100 days).[1]

__Treatment Evaluation__: Paired bark samples were removed from each tree during mid-August. Two bark samples (232 cm^2 each) were taken on opposite sides of the bole along mid-line at 3 m, and another pair at a 20 cm top. Each bark sample was evaluated for treatment efficacy as follows: (1) number of beetle attacks per m^2 of bark, (2) number (partial and whole) and mean gallery length per m^2 of bark, and (3) number of beetle brood per m^2 of bark.

__Analysis__: Variables were subjected to a one-way analysis of variance (ANOV). Data were transformed, if necessary, by $y=\sqrt{x + 3/8}$ to overcome variations due to zero counts which were expected to exist in the treated trees. If significant differences resulted, Duncan's Multiple Comparison Test (P=0.05) of the means was undertaken.

RESULTS AND DISCUSSION

There were no significant differences between treatments and checks with respect to the variables (Table 1). Even though there appears to be a reduction in average number of attacks per m^2 of bark, the variability within a treatment was significant, negating any treatment affect. These results are similar to those obtained in the 1984 study (Holsten and Werner 1985) which tested a slow release granular MCH formulation. This lack of suppression and/or elimination of spruce beetle attacks was probably due to the lower than expected release rate of the formulated MCH.

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[1]Steve Burke, Phero Tech Inc., Personal Communication, March 1985.

As previously mentioned, the MCH bubble cap release rates were laboratory calibrated at 20°C, but temperatures in the study site seldom got above 20°C (Figure 1). The average mean daily temperature from the end of May through the first week of July was only 11°C. In addition, treatment evaluations in August indicated that substantial amounts (not quantified) of MCH remained in the bubble caps.

Based on the positive results obtained from the use of the bubble caps in Montana, further tests are proposed in Alaska in 1986; however, a modification of the membrane composition and/or thickness must be done in order to increase the elution rate of MCH.

TABLE 1. Average number per m^2 of spruce beetle attacks, galleries, progeny, and gallery length by treatment.

Treatment	No. of Trees	Av. No. Attacks	Av. No. Galleries	Av. No. Larvae	Av. No. Eggs	Av.Gallery length(cm)
1.5[1]	10	43.5 ± 27^{a}[2]	139.2 ± 37^{a}	1393.7 ± 746^{a}	483.7 ± 700^{a}	6.6 ± 1^{a}
3	10	47.7 ± 32^{a}	137.1 ± 86^{a}	1251.9 ± 914^{a}	157.5 ± 250^{a}	6.4 ± 1^{a}
Control	10	60.1 ± 37^{a}	181.4 ± 85^{a}	1878.4 ± 1170^{a}	213.2 ± 263^{a}	6.1 ± 2^{a}

[1]Treatments: 1.5 and 3 m spacing between bubble caps along upper bole surface.

[2]Numbers in the same column followed by the same letters are not significantly different.

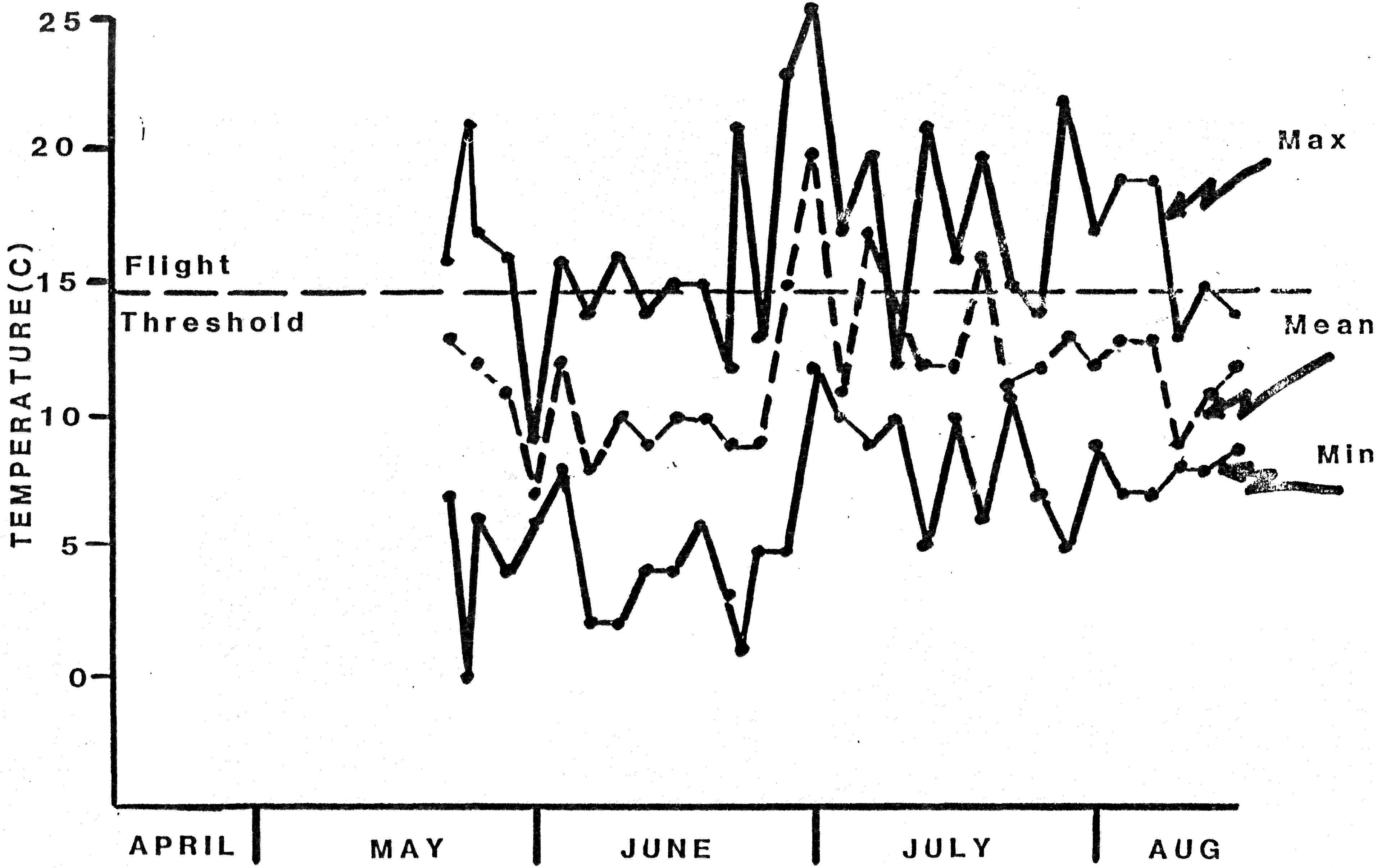

Fig. 1. Maximum, minimum, and mean temperatures for Juneau Crk., Alaska, 1985.

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